



**COMP-ECO**

## **PROJECT DELIVERABLE**

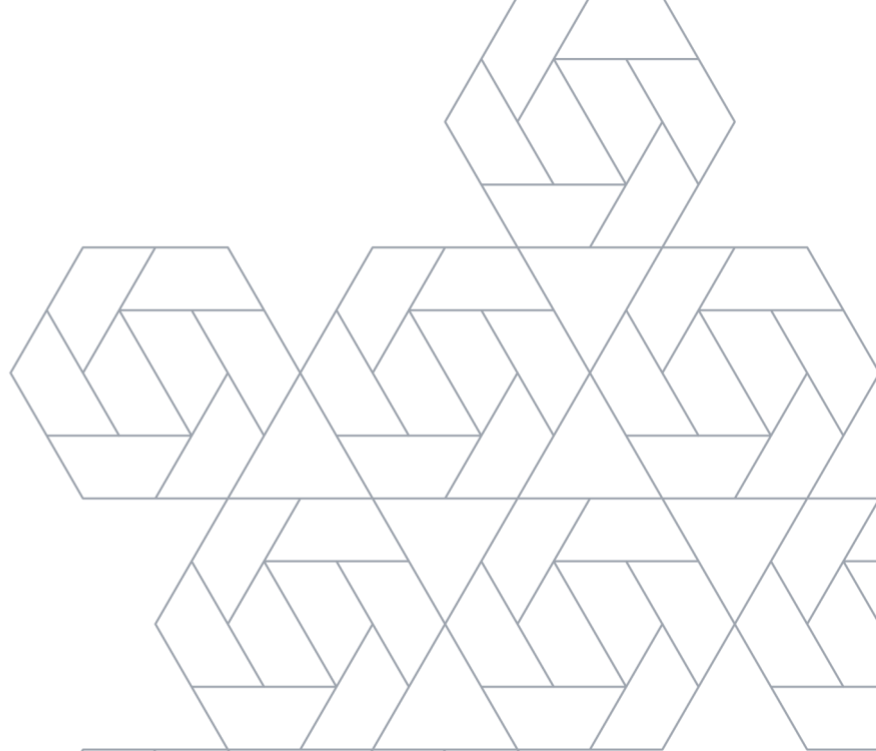
### **D5.2 DATA MANAGEMENT PLAN**

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3.2 – 27/06/2024	Anna Zmiiievska (TPF) updated section 4 regarding the responsibility for data management

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# 1. INTRODUCTION

## 1.1. ABOUT THE COMP-ECO PROJECT

The COMP-ECO project is aiming at improving the research excellence of the Polish Mazovia region-based ecosystem in the field of Fibre-Reinforced Polymer (FRP) multifunctional composites and smart structures. The ecosystem is formed by 3 organizations: Technology Partners Foundation (TPF), Air Force Institute of Technology (AFIT) and Warsaw University of Technology (WUT). These 3 Polish partners will be supported by two leading EU universities: Delft University of Technology from the Netherlands and Technische Universität Dresden from Germany.

For 3 years the COMP-ECO partners jointly implement exploratory research work to develop a technology for a permanent on-line non-destructive quality assessment of composite structures. For this purpose, 2 possible innovative sensing capabilities are being developed: (1) self-diagnostics capabilities through the introduction of electroconductive carbon nano tubes in the composite's matrix during the manufacturing process and (2) self-sensing capability through embedding PZT sensors, encapsulated in a thermoplastic fibrous material (veils), in the composite structure.

In addition to the research work, the project will organize technical workshops aimed on raising the research profile of Mazovian composite community, and management and administrative training workshops to strengthen research management capacities and administrative skills of the Polish partners' administrative staff.

The COMP-ECO activities will establish and strengthen a regional competence hub formed by TPF, AFIT and WUT, whose increased science and innovation capacities will lead to more ambitious collaboration with top EU research organisations and industry, higher participation in Horizon Europe, and a more attractive educational offer for students and young researchers.

## 1.2. SCOPE OF THIS DELIVERABLE

The purpose of this **Data Management Plan (DMP)** is to analyse the data to be collected and/or generated in the frame of the COMP-ECO project and to outline the data management principles to be used by the consortium to handle these data during the project implementation and after its completion. In brief, The DMP defines how the data will be created; how it will be documented; who can access it; where it will be stored; whether it will be shared and where it will be preserved.

This document is the first version of the DMP, which will be a "living" document during the lifespan of the project. The DMP will be modified and refined in the course of the project implementation, as some changes or updates will occur.

The present DMP is created on the basis of the EC's Data Management Plan Template Version 1.0, 05 May 2021, and consists of the seven separate sections:

- Section 1: presents introductory information about the project and the deliverable content.
- Section 2: provides an overview of the data sets, which will be produced in the project. It highlights the purpose of the data collection and/or generation and relation to the project objectives, describes the data origin, and formats as well as information on the research data utility. Last but not least, it clearly points out, which datasets will be made openly accessible.
- Section 3: explains the policy to be implemented by the COMP-ECO team to make project research data **findable, accessible, interoperable and reusable (FAIR)**.
- Section 4: highlights main aspects related to resources available for data management including data management responsibilities and costs during the project and after its completion.
- Section 5: presents the measures to be undertaken by the COMP-ECO consortium to ensure the research data security.

Annex 1 presents a template for description of COMP-ECO's project open datasets. Later on, the Annexes will present full information about the datasets, which are already made open.

## 2. DATA SUMMARY

The Project aims at raising scientific excellence mainly through sharing knowledge and experience. Appropriate management of large amounts of data will thus be crucial to achieving the Project's success.

This data will relate to:

- a) The knowledge being shared in the form of technical and administrative workshops.
- b) Materials gathered and/or prepared during temporary positions and externships.
- c) The joint research being performed.
- d) Consultations with the scientific and industrial advisory board (SIAB).
- e) Project management.

The data will be useful for:

- a) Senior and young researchers, students and administration staff of the widening Partners to gain state-of-the-art knowledge and upgrade their skills.
- b) Senior researchers of the widening Partners to prepare new curricula.
- c) The researchers of all Partners conducting the joint exploratory research to achieve their research objectives.



- d) Senior researchers of all Partners to prepare the Joint long-term research collaboration strategy (D2.2) and the Roadmap for industrial implementation of Multifunctional Composites and Smart Structures (D5.3).
- e) All participants to appropriately manage the Project.

The **research data** to be generated and/or collected and processed by the COMP-ECO project are preliminary described in the **Error! Reference source not found.**, which identifies two categories of research data:

- **Open Research Data** – any form of non-confidential data needed to validate the results presented in scientific publications resulting from project research activities in Open Access Journals and Non-Confidential products of research (including but not limited to datasets, designs, code, etc.) created and/or used in the framework of the project, where “Non-Confidential” means that such data can be made (or is already) open.
- **Sensitive Research Data** – any form of confidential data and products of research (including but not limited to datasets, designs, code, etc.) created and/or used in the framework of the project, which will present high innovation potential and possibility for commercialization. For this category the Consortium will consider either keeping data restricted for project participants for internal user or apply for a patent in order to commercially exploit (in this case the appropriate IPR protection measures, e.g. NDA, will be taken for data sharing outside the consortium).

The table below presents the detailed description of project data, purpose of their collection/generation, formats, potential data utility, which means to whom these data might be useful. This table will be updated in the course of the project.

**TABLE - RESEARCH DATASET DESCRIPTION**

Dataset Description	Relevant research task No	Purpose and relation to the project objectives	Partners involved in generation/ processing	Category	Data Format	How to be exploited or made accessible	Data utility (to whom data might be useful)
Data on previous research on the use of carbon-based sensors in FRP structures	Task 1, 2, 3, 7	Analysis of the current state-of-the-art in the use of sensors in FRP structures and determination of boundary conditions for carbon-based sensors.	TPF, WUT, TUD	Open	Docx documents and research articles in relevant journals, conference proceedings	Public online repository	1) COMP-ECO Participants 2) Researchers and professionals working in the field of multifunctional FRP composites and smart structures
Laminates materials selection	ALL	List of selected materials for manufacturing FRPs, allowing carbon-based sensors to be introduced into their structure	TPF, WUT, TUD	Open	Docx documents including technical data sheets	Public online repository	1) COMP-ECO Participants 2) Researchers and professionals working in the field of FRP multifunctional composites and smart structures
Sensors materials selection	ALL	List of selected materials that meet the specified requirements and allow the manufacture of sensors.	TPF, WUT, AFIT	Open	Docx documents including technical data sheets	Public online repository	1) COMP-ECO Participants 2) Researchers and professionals working in the field of carbon-based sensors
Samples design	Task 1-6	Design a method of implementing sensors into the FRP structure to evaluate the performance of the damage monitoring system.	TPF, WUT, TUD, TUDelft	Sensitive	Docx documents including images	Sensitive data for IPR- will not be made accessible until IPR protection has been granted/published	1) COMP-ECO Participants 2) Researchers and professionals working in the field of FRP multifunctional composites and smart structures

Dataset Description	Relevant research task No	Purpose and relation to the project objectives	Partners involved in generation/ processing	Category	Data Format	How to be exploited or made accessible	Data utility (to whom data might be useful)
Laminates manufacturing	ALL	Optimization of FRP fabrication parameters along with the use of sensors to achieve a high-quality polymer composite structure.	TPF, WUT, TUD, TUDelft	Sensitive	Docx documents	Sensitive data for IPR- will not be made accessible until IPR protection has been granted/published	1) COMP-ECO Participants 2) Researchers and professionals working in the field of FRP multifunctional composites and smart structures
Sensors characterization	ALL	Evaluation of fabricated sensors used to monitor polymer composite structure.	TPF, AFIT, WUT	Sensitive	Docx documents including tables, figures, and graphs. Excel sheets with test results	Sensitive data for IPR- will not be made accessible until IPR protection has been granted/published	1) COMP-ECO Participants 2) Researchers and professionals working in the field of carbon-based sensors
Laminates characterization	Task 1, 2, 3, 4, 5, 7	Verification of the quality of manufactured laminates and the effectiveness of carbon-based sensors.	TPF, WUT, TUDelft	Sensitive	Docx documents including tables, figures, and graphs. Excel sheets with test results	Sensitive data for IPR- will not be made accessible until IPR protection has been granted/published	1) COMP-ECO Participants 2) Researchers and professionals working in the field of FRP multifunctional composites and smart structures
Physicochemical properties of the materials used to fabricate sensors	Task 1, 2, 3, 5, 6	The results of the analysis performed to characterize the physicochemical properties of the polymer composites with carbon fillers selected to make the sensors, such as electrical conductivity, thermal stability, microstructure observations	TPF, WUT	Sensitive	Raw data from the instruments; docx, excel sheet	Sensitive data for IPR- will not be made accessible until IPR protection has been granted/published	COMP-ECO participants Advisory Board



Dataset Description	Relevant research task No	Purpose and relation to the project objectives	Partners involved in generation/ processing	Category	Data Format	How to be exploited or made accessible	Data utility (to whom data might be useful)
Technical parameters of the processes used to fabricate sensors	Task 1, 2, 3, 7	The reports including the detailed processing parameters of the strips, veils and fibers containing carbon nanotubes which were selected to be used as sensors in FRP	TPF, WUT	Sensitive	Docx, excel sheet., pdf	WUT and TP know-how	COMP-ECO participants Advisory Board
Demonstrator design and manufacturing	Task 7	Fabrication parameters of the selected demonstrator	TU Dresden, WUT, TPF	Sensitive	Docx documents including tables, figures, and graphs.  Excel sheets with test results	Sensitive data for IPR- will not be made accessible until IPR protection has been granted/published	1) COMP-ECO Participants 2) Researchers and professionals working in the field of FRP multifunctional composites and smart structures
Demonstrator characterization	Task 7	Experimental data obtained from testing the demonstrator	TU Dresden, WUT	Sensitive	Docx documents including tables, figures, and graphs.  Excel sheets with test results	Sensitive data for IPR- will not be made accessible until IPR protection has been granted/published	1) COMP-ECO Participants 2) Researchers and professionals working in the field of FRP multifunctional composites and smart structures
Signals acquired by PZT sensors integrated with composite specimens	Task 4	Analysis of PZT sensors effectiveness in composite structures monitoring	AFIT, TUDresden	Open	compressed (.zip) dataset of text files containing signals along with description of file format and the experiment	Public online repository	Researchers and professionals working in the field of applications of PZT sensors

Dataset Description	Relevant research task No	Purpose and relation to the project objectives	Partners involved in generation/ processing	Category	Data Format	How to be exploited or made accessible	Data utility (to whom data might be useful)
Spatio-temporal distribution of elastic waves excited by PZT sensors	Task 4	Analysis of PZT sensors effectiveness in composite structures monitoring	AFIT, TUDresden	Open	Compressed Polytec's binary file format (.svd). The data can be decompressed with use of <a href="#">Polytec's FileAccess DLL software</a> library which enables external programs (such as Visual Basic, Matlab, LMS Test.Lab, VSI Rotate) that support the Microsoft® Standard Component Object Model (COM) to access information and data included in Polytec's measurement files.	Available upon request (signal database might be too large to be stored in free open repositories)	Researchers and professionals working in the field of applications of PZT sensors
Signals acquired by sensors installed on the demonstrator of the technology	Task 4, 7	Validation of sensors on technology demonstrator	AFIT, TUDresden, WUT	Open	compressed (.zip) dataset of text files containing signals along with description of file format and the experiment	Public online repository	Researchers and professionals working in the field of Structural Health Monitoring
NDT tests results	Task 2, 3, 5	Analysis of structure, quality control and damage detection, comparative data for SHM systems	AFIT, TUDelft	Sensitive	Docx documents including images, Images (bmp, jpg, png) specific files from NDT equipment	Data will be accessible for project members	COMP-ECO Participants

Dataset Description	Relevant research task No	Purpose and relation to the project objectives	Partners involved in generation/ processing	Category	Data Format	How to be exploited or made accessible	Data utility (to whom data might be useful)
Mechanical tests results	Tasks 1-4	Data for numerical simulation Analysis of sensors presence influence on mechanical properties of composites	AFIT, WUT, TU Dresden, TU Delft	Sensitive	Docx/xls documents including images and charts specific files from mechanical tests equipment	Data will be accessible for project members	COMP-ECO Participants
Characterization of electrical parameters of fibers	Tasks 1, 2, 5, 6	Analysis of fibers for sensor development	AFIT, TPF	Open	compressed (.zip) dataset of text files containing signals along with description of file format and the experiment	Public online repository	Researchers and professionals working in the field of condition monitoring
Characterization of fibers based sensor integrated with composite specimens	Tasks 1,2,3,5,6	Analysis of fibers based sensor for evaluation the effectiveness in composite structures monitoring	AFIT, WUT, TFP	Open		Public online repository	Researchers and professionals working in the field of condition monitoring
Materials from technical workshops	n/a	Materials from the conducted technical workshops (on Design, on Manufacturing, on Testing, on Sustainability) given by TU Delft and TU Dresden to Polish Partners (presentation slides, photos, video records)	TU Dresden, TU Delft	Open	pptx; docx, images	Public online repository	1) COMP-ECO Participants 2) Researchers, PhD students, MSc students working in the field of multifunctional fiber-reinforced polymer composites and smart structures
Materials from research management and administrative workshops	n/a	Materials from the non-research workshops given by TU Delft and TU Dresden to Polish Partners (presentation slides, photos, video records)	TU Dresden, TU Delft	Open	pptx; docx, images	Public online repository	1) COMP-ECO Participants 2) Researchers and research support specialists (accountants, project managers, tech transfer specialists)

## 3. FAIR DATA

### 3.1. MAKING DATA FINDABLE

#### **Metadata**

Metadata is the data which enables others identify and find the open research data in a repository. Proper and full metadata will allow other researchers determine the usefulness of specific datasets for their needs and if so reuse the data for their research.

The COMP-ECO open research data will be made findable through the Zenodo research data repository (<https://zenodo.org>) under the Creative Common Public Domain Dedication (CC 0 license).

According to Zenodo principles, every published record on Zenodo will be assigned a DOI (Digital object identifier). Zenodo's metadata is compliant with DataCite's Metadata Schema minimum and recommended terms, with a few additional enrichments. Metadata of each record is sent to DataCite servers during DOI registration and indexed there.

According to the requirements of Grant Agreement (Annex 5, section Communication, dissemination, open science and visibility (— Article 17)), the metadata of deposited publications will be open under a Creative Common Public Domain Dedication (CC 0) or equivalent, in line with the FAIR principles (in particular machine- actionable) and provide information about the following:

- publication (author(s), title, date of publication, publication venue);
- Horizon Europe funding;
- Grant project name, acronym and number;
- Licensing terms;
- Persistent identifiers for the publication, the authors involved in the action and, if possible, for their organisations and the grant.
- Where applicable, the metadata must include persistent identifiers for any research output or any other tools and instruments needed to validate the conclusions of the publication.

The datasets to be placed in a repository will be supplemented with the information on the methodology used to collect the data, analytical and procedural information, definitions of variables, units of measurement, any assumptions made, the format and file type of the data and software used to collect and/or process the data. If a dataset requires any other specific documentation to enable it reuse, it will be mentioned either in a file header, or in a 'readme' text file.

## Search keywords

Keywords will be indicated for each entry in the repository to feed search queries and optimize possibilities for re-use. Example keywords include:

- carbon fiber-reinforced composite materials, material characterization, composite structures monitoring, PZT sensors

## Naming conventions and versions

All files in a datasets placed to the repositories will be structured by using a name convention containing project name, dataset No, dataset name, date and version number:

**COMP-ECO\_DSX\_Datasetname\_xxxx.yy.zz\_vX.ext**

*(where .ext is a generic extension)*

Zenodo supports the DOI versioning, which enables users to update the record's files after they have been made public and researchers to easily cite either specific versions of a record or to cite, via a top-level DOI, all the versions of a record.

## 3.2. MAKING DATA OPENLY ACCESSIBLE

**Sensitive Research Data** will be accessible to project participants only. Such data will be first of all stored at the PCs of the project participants which generate and/or collect data. or in their institutional secure servers. In addition, Zenodo secure storage will be considered, which provides the possibility to house closed and restricted content, so that artefacts can be captured and stored safely.

**Open access** will be provided to non-confidential project outputs. First of all, the peer-reviewed scientific publications relating to the COMP-ECO results will be published adhering to suitable "Open Access":

- at the latest at the time of publication, a machine-readable electronic copy of the published version or the final peer-reviewed manuscript accepted for publication, is deposited in a ZENODO;
- immediate open access is provided to the deposited publication via the repository, under the latest available version of the Creative Commons Attribution International Public Licence (CC BY).

The copyright to the research publication will be retained by the author, and adequate licences to publisher will be granted.

At the same time, the **open research data** needed to validate the results presented in such open access publications will be deposited to the ZENODO repository together with associated metadata, to make it possible for third parties to access, mine, exploit, reproduce and disseminate these data. ZENODO is a general-purpose open-access repository developed

under the European OpenAIRE program, which allows researchers to deposit data sets, research software, reports, and any other research-related digital artefacts as well as download and use available content free of charge.

Some of the research data will be produced in common electronic document/data/image formats (.docx, .xls, .pdf, jpg, etc.) that can be accessed via commonly-used methods and open software. For some works the specific software will be needed, e.g. Polytec's FileAccess DLL software library will be needed to access data on Spatio-temporal distribution of elastic waves excited by PZT sensors. In such cases information about tools and instruments necessary for validating the result will be also provided.

### 3.3. MAKING DATA INTEROPERABLE

To make COMP-ECO open research data interoperable, which means allowing data exchange and re-use between researchers, institutions, organisations, countries, etc. the standards for formats, as much as possible compliant with available (open) software applications will be applied. In particular, re-combinations with different datasets from different origins will be facilitated.

The distinct and standard terminology will be used in all datasets and in descriptive metadata fields to allow accurate and quick indexing and retrieval of relevant data. Appropriate keywords (see Section 3.1) will be used for indexing and subject headings of data and metadata. The keywords will be updated in the course of project implementation to ensure that the most recent and adequate terminology is applied and so to maintain interoperability.

This will be as well relevant to metadata in ZENODO, which use a formal, accessible, shared, and broadly applicable language for knowledge representation.

### 3.4. INCREASE DATA RE-USE

#### **Data licensing**

The project will use one or several main Creative Commons licenses to protect an ownership of datasets or their parts. Preliminary, the preference will be given to Attribution-NonCommercial-ShareAlike 4.0 International license (CC BY-NC-SA 4.0). Decision regarding appropriate licence selection will be done by consortium simultaneously with the making decision as for providing open access to dataset or its specific part.

#### **Date of data release**

All open research data will be made available through ZENODO repository immediately after the consortium decision to provide open access.



### **Re-use by third parties**

Re-use of sensitive research data will be limited to project partners and is regulated by the COMP-ECO Consortium Agreement.

Re-use by third parties of open research data to be deposited to ZENODO repository will be subjected to standard restrictions of applied license, e.g.:

- Attribution: requires to give appropriate credit, provide a link to the license and indicate if changes were made.
- ShareAlike: requires to use the same licence as original on all derivative works based on original data
- Non-Commercial: prohibits the use of the dataset for commercial purposes.

Open research data deposited to ZENODO repository will remain re-usable throughout the lifetime of the repository.

### **Data quality**

Each project participant will be responsible for quality of data it collect and/or produce and will apply its regular procedures and protocols focused on data quality assurance and control.

## **4. ALLOCATION OF RESOURCES**

### **Costs for making data FAIR**

COMP-ECO partners will publish scientific articles to disseminate key project results in peer-reviewed journals, which provide full open access. Average open access fee for COMP-ECO-relevant scientific journals (e.g. Composite Structures (Elsevier; IF: 5.41), Smart Materials and Structures (IOP Publishing; IF: 3.59), Mechanical Systems and Signal Processing (Elsevier; IF: 6.82), Structural Health Monitoring (SAGE Publications; IF: 5.93), Composites Part A: Applied Science and Manufacturing (Elsevier, IF 9.46)) is about 2,000 Euro.

Fees associated with open access scientific publications are distributed between TPF, WUT and AFIT (2 OA articles per each partner + several conference fees) and will be covered by the COMP-ECO project costs.

Machine-readable electronic copies of project open access publications as well as bibliographic metadata and associated research data, needed to validate the results presented in scientific publications, will be deposited to Zenodo research data repository, which is free of charge.

### **Responsibility for data management**

Each project participant is responsible for management of data that its researchers produce, including data capture, metadata production, data quality, storage and backup, and data

archiving. On individual level, the following team members are responsible for internal data management in accordance with their institutional policies:

- TPF: Rafal Kozera
- AFIT: Marta Baran
- WUT: Kamil Dydek
- TU Delft: Otto Bergsma
- TU Dresden: Georgios Tzortzinis

When it comes to management of data generated through collaboration within the consortium, for those data marked as “open” in the table “research dataset description” in section 2 of this document, it is the responsibility of TPF (Anna Zmiievska) to oversee how the jointly generated data are exploited and ensure that they are made assessable via the defined open repository. Also, she will ensure that all data needed to validate the results presented in joint open access publications coming from COMP-ECO research are deposited to the open repository together with associated metadata in accordance with the provisions of section 3.2 of this document.

For those data marked as “sensitive” in the table “research dataset description” in section 2 of this document, it is the responsibility of respective research task leader to oversee how the jointly generated data under this research task are exploited and ensure that they are managed in accordance with the provisions of this document. The research tasks leaders are:

- Research task 1 – CNT-doped filaments as strain gauges: Georgios Tzortzinis (TU Dresden)
- Research task 2 - Conductive CNT-doped strips or conductive paths as heaters for thermography: Kamil Dydek (WUT)
- Research task 3 - Conductive CNT-doped veils as delamination sensors: Paulina Latko-Duralek (WUT)
- Research task 4 - Integration of PZT sensors: Michał Dziendzikowski (AFIT)
- Research task 5 - Insulation of sensors: Kamil Dydek (WUT)
- Research task 6 - Connection wires and contact points: Artur Kurnyta (AFIT)

In case if the data are generated by more than one research task, it will be the responsibility of WP1 leader.

In case of necessity the Data Steward (Heather Andrews Mancilla) from TU Delft’s Faculty of Aerospace Engineering will be consulted on management of data generated through collaboration within the consortium.

Overall data management responsibility beyond the project life will be defined in the subsequent versions of this document during project year 3.

As for materials to be deposited to the online repository at the project website, the TPF (Anna Zmievskaya) will be responsible for its deposition and update.

### **Long term data preservation**

Materials from workshops, staff exchanges and selected materials from the exploratory research will be catalogued in and disseminated through the online open-access project results repository for further use by researchers and students to gain state-of-the-art knowledge, by academic staff to develop curricula and by industry to visualise application possibilities. The online open-access project results repository will be maintained minimum for 3 years after the project completion.

## **5. DATA SECURITY**

### **Data storage, transfer and backup**

Employees of the organizations involved in research activities are responsible for storage and regular backups of data they are producing and/or processing. For this purpose, regular practices and regulations of each partner will be applied.

Whatever the case, the following principles will be followed by all project participants to ensure data security:

- store data in at least two separate storage media (e.g. hard drive and DVD) to avoid data loss;
- check data integrity periodically;
- limit the use of USB flash drivers;
- store data in a proprietary formats, which are widely used.

Joint datasets will be stored at and transferred via the cloud service MS Teams established by AFIT on their internal account.

COMP-ECO website internal shared space facility provided by WIX hosting, which includes the HTTPS and SSL protocols, ensuring secure communication and encryption of exchanged data. Each project participant has a personalized login and password to access the COMP-ECO internal shared space, which is managed by TPF. The internal shared space has a feature of giving individual access rights for groups of members and individual members.

Open research data deposited to Zenodo repository will be stored and backed up in line with repository's policy, which includes multiple file replicas in a distributed file system, backed up to tape on a nightly basis.